

**WHAT IS CLAIMED IS:**

1           1. An apparatus comprising:  
2                   a) a carousel that is rotatable around an axis, the carousel  
3 comprising a plurality of reaction mounts, each reaction mount comprising at least one  
4 reaction well arranged on a radius with respect to the axis, the radii spaced apart at equal  
5 angles, whereby the wells are arranged in at least one concentric circle around the axis;  
6                   b) a rotator that rotates the carousel step-wise around the axis, each  
7 incremental step docking each of the reaction mounts at a separate station;  
8                   c) a fluid delivery system that delivers liquid to at least one  
9 reaction well in each of a plurality of docked reaction mounts;  
10                   d) a drain system that drains liquid by differential pressure from at  
11 least one reaction well of each of a plurality of docked reaction mounts; and  
12                   e) a programmable digital computer that controls the rotator, the  
13 fluid delivery system and the drain system.

1           2. The apparatus of claim 1 wherein:  
2                   (i) each reaction well comprises a drainage hole;  
3                   (ii) the carousel comprises a plate which comprises a  
4 plurality of liquid conduits that connect with the drainage holes and are engagable with  
5 the drain system; and  
6                   (iii) the drain system is a vacuum drain system comprising:  
7                           (1) a plurality of vacuum lines that connect with  
8 vacuum source and  
9                           (2) conduit engagement means that engage the  
10 vacuum lines with a plurality of the liquid conduits when the reaction mounts are docked  
11 at a station, whereby liquid in the reaction wells is drained through the vacuum lines.

1           3. The apparatus of claim 2 wherein:  
2                   (i) each liquid conduit comprises:  
3                           (1) a depression in the plate below the reaction  
4 mount which forms a chamber with the reaction mount, wherein the chamber  
5 communicates with the drainage holes of the reaction mount;  
6                           (2) an exit port exiting under the plate; and

7 (3) a bore through the plate the connects the

8 chamber with the exit port; and

9 (ii) the conduit engagement means comprises:

10 (1) a non-rotating connector plate positioned under

11 the carousel; the connector plate having an engagement port that is engagable with the

12 exit port positioned at each station, wherein each of a plurality of the engagement ports is

13 connected to a vacuum line; and

14 (2) an actuator that raises the connector plate to

15 engage the plurality of engagement ports with the plurality of exit ports.

1                           5.     The apparatus of claim 2 wherein the number of reaction mounts  
2     equals the number of stations.

1 6. The apparatus of claim 2 wherein the carousel comprises 24  
2 reaction mounts.

1                   9.     The apparatus of claim 2 further comprising a temperature  
2     controlling system that regulates the temperature of at least one reaction mount docked at  
3     a station.

1                   10.    The apparatus of claim 2 further comprising an optical analyzing  
2     system that optically analyzes fluid in a well of at least one reaction mount docked at a  
3     station.

1                   11.    The apparatus of claim 4 wherein:  
2                           (i) each reaction mount comprises a plurality of wells;  
3                           (ii) each dispensing module comprises a motor that moves  
4     the dispensing head to positions suitable for delivering fluid to each of the plurality of  
5     wells.

1                   12.    The apparatus of claim 4 wherein at least one station comprises  
2     both a dispensing module and an engagement port connected to a vacuum line.

1                   13.    The apparatus of claim 4 wherein each reaction mount comprises a  
2     plurality of wells; the wells being spaced apart about the distance of wells in a row of a  
3     96-well microtiter plate.

1                   14.    The apparatus of claim 4 further comprising an airtight chamber  
2     that comprises the rotator, the dispensing assembly, the carousel and the connector plate.

1                   15.    The apparatus of claim 11 wherein at least one dispensing head is  
2     connected to a plurality of fluid dispensers by fluid lines.

1                   16.    The apparatus of claim 14 wherein the chamber comprises an upper  
2     chamber and a lower chamber wherein the upper chamber comprises the rotator and the  
3     dispensing assembly, and the lower chamber comprises the carousel and the connector  
4     plate, and wherein the lower chamber can be in a raised or lowered position with respect  
5     to the upper chamber, and wherein in the raised position, the chamber forms an airtight  
6     seal.

1                   17.    The apparatus of claim 14 comprising a regulator which regulates a  
2     directional flow of a gas to the upper chamber.

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1                   18. The apparatus of claim 16 further comprising a bellows connected  
2 to the regulator and to the upper chamber which functions as a reservoir for the gas.

1                   19. A method for performing in parallel a series of physical steps in a  
2 chemical reaction protocol, wherein the protocol generates a chemical linkage in a parent  
3 molecule, the method comprising:

4                   a) providing a carousel that is rotatable around an axis, the carousel  
5 comprising a plurality of reaction mounts, each reaction mount comprising at least one  
6 reaction well arranged on a radius with respect to the axis, the radii spaced apart at equal  
7 angles, whereby the wells are arranged in at least one concentric circle around the axis,  
8 wherein each well comprises the parent molecule attached to a solid support;

9                   b) rotating the carousel step-wise around the axis at least once,  
10 each incremental step docking each of the reaction mounts at a separate station, wherein  
11 (1) each station is dedicated to perform a physical step in the series during a docking,  
12 wherein the physical steps include adding a liquid to a well, draining a liquid from a well,  
13 and incubating; and (2) the stations are arranged to perform the series of physical steps in  
14 sequence; and

15                   c) performing, with each rotation of the carousel, the series of  
16 physical steps in a reaction well of each of at least two of the reaction mounts, whereby a  
17 chemical linkage is generated in the parent molecule.

1                   20. The method of claim 19 comprising rotating the carousel a plurality  
2 of times.

1                   21. The method of claim 19 comprising, with at least one rotation of  
2 the carousel, performing the series of steps in a reaction well of all of the reaction mounts.

1                   22. The method of claim 19 wherein the series of steps is not  
2 performed on a reaction well of at least one reaction mount during at least one rotation,  
3 whereby the reaction mount skips the protocol during that rotation.

1                   23. The method of claim 19 wherein the parent molecule is cleavable  
2 from the solid support.

1                   24. The method of claim 19 wherein there are 24 stations.

1                   25.    The method of claim 19 wherein the chemical linkage links a  
2 component to the parent molecule.

1 26. The method of claim 19 carried out in an inert atmosphere.

1                   27. The method of claim 19 wherein the physical steps further include  
2 washing a well, wherein washing comprises both adding fluid to a well and draining fluid  
3 from a well at a single station.

1 28. The method of claim 19 wherein the steps include heating a well.

1 29. The method of claim 19 wherein the steps include optically  
2 analyzing a well.

1 35. The method of claim 32 wherein the polymer is a nucleic acid.

1 36. The method of claim 32 wherein the polymer is DNA.

1 37. The method of claim 32 wherein the polymer is RNA.

1 38. The method of claim 32 wherein the polymer is a peptide nucleic  
2 acid.

1 39. The method of claim 32 wherein the polymer is a polypeptide.

3 (i) washing the support;  
4 (ii) dispensing a liquid comprising a deblocking agent to  
5 remove the protecting group;  
6 (iii) draining the liquid comprising the deblocking agent;  
7 (iv) washing the support;  
8 (v) dispensing a liquid comprising a coupling activator;  
9 (vi) dispensing a liquid comprising a protected nucleotide;  
10 (vii) draining the liquid comprising a protected nucleotide;  
11 (viii) dispensing a liquid comprising a capping agent;  
12 (ix) draining the liquid comprising the capping agent;  
13 (x) washing the support;  
14 (xi) dispensing a liquid comprising an oxidizer; and  
15 (xii) draining the liquid comprising the oxidizer.

1                           42.    The method of claim 35 wherein the monomer is a modified  
2    nucleotide comprising a minor groove binder.

1                           44. The method of claim 39 comprising rotating the carousel to  
2 produce a polypeptide having between 5 and 50 amino acids.

1                           45.     A method for performing in parallel a series of physical steps in a  
2     chemical protocol, the method comprising the steps of:

3 a) providing a carousel that is rotatable around an axis, the carousel  
4 comprising a plurality of reaction mounts, each reaction mount comprising at least one  
5 reaction well arranged on a radius with respect to the axis, the radii spaced apart at equal  
6 angles, whereby the wells are arranged in at least one concentric circle around the axis,  
7 wherein each well comprises the parent molecule attached to a solid support;

8 b) providing a rotator that rotates the carousel step-wise around the  
9 axis, each incremental step docking the reaction mounts a station, wherein: (1) each  
10 station is dedicated to perform a physical step in the series during a docking and (2) the  
11 stations are arranged in series from an initial station that performs an initial physical step  
12 in a series of physical steps in a chemical protocol to a final station that performs a final  
13 physical step in the series of physical steps;

14 c) performing an initial rotation of the carousel around the axis,  
15 wherein the stations begin to perform the series of physical steps as a reaction mount  
16 docks at the initial station; and

17 d) performing a final rotation of the carousel around the axis,  
18 wherein the stations cease to perform the series of physical steps as a reaction mount  
19 docks at the final station;

20 whereby the initial and final rotations result in one complete series  
21 of steps on a reaction well of each reaction mount.

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